# CHAPTER 8:
# Reducing Pollution



# Goal:

## Significantly reduce the amounts, sources, and cumulative impacts of pollution on coral reefs by fully implementing existing federal and state authorities.

Healthy coral reefs require good water quality to grow, remain viable, and provide ecosystem benefits. Both land-based and sea-based pollution can threaten reef resources by harming sensitive species, altering species compositions, disrupting critical ecological functions (photosynthesis), and impeding the normal growth and settlement of stony corals and other benthic invertebrates. Reef systems are impacted by a variety of pollutants, including sediments, nutrients, chemical contaminants, marine debris, and invasive species. Pollution enters reef ecosystems in many ways, ranging from specific point-source discharges such as sewage pipes and vessels, to more diffuse sources such as run-off associated with agriculture, coastal development, and road construction. Reef degradation is even greater in areas where the loss of wetlands or other associated habitats has reduced the system's natural ability to filter nutrients and other pollutants before reaching the reefs. Although

The Palacios farm in the Obyan area of Saipan. The farmer is an NRCS cooperator and is currently under an EQIP contract for management practices on the tilled areas. Practices include Conservation Crop Rotation, Nutrient Management and Pest Management. NRCS will be working with them to apply other conservation practices in the future.

there is wide variation among the sources, characteristics, and impacts of pollution in U.S. jurisdictions, significant reductions or potential elimination of much of the pollution could be accomplished by full implementation of existing state and federal regulations and voluntary programs.

The USCRTF identified pollution as a priority area for action. Members have taken a number of actions to address these issues, such as developing regulations to limit the types and amounts of land-based waste being discharged, increasing fines for violators of coral reef environmental protection regulations, implementing new pollution-control measures, and establishing federal—local partnerships to voluntarily implement best management practices within coral reef watershed areas.

## Accomplishments by Objective

**Objective 1:** *Reduce sedimentation and other land-based sources of pollution by implementing conservation management practices in coastal watersheds through public/private partnerships, incentive-based measures, regulatory measures, technical and financial assistance, habitat restoration, and other activities.*

The USDA's NRCS works closely with local farmers and land-owners, providing technical assistance and helping identify and implement conservation practices to reduce runoff of surface water and associated nutrients and pesticides impacting nearshore coral reef ecosystems. Examples of conservation practices include: cover crops, pest management, residue management, conservation crop rotation, contour farming, irrigation water management, field borders, waste utilization, and nutrient management.

NRCS, working through the 2002 Farm Bill, made $30 million available for application to land-based conservation efforts within the Pacific Islands Area through the Environmental Quality Incentives Program (EQIP). EQIP is a voluntary program providing assistance to farmers and ranchers who face threats to soil, water, air, and related natural resources on their land. Through EQIP, NRCS provides assistance to agricultural producers in promoting agricultural production and environmental quality as compatible goals, optimizing environmental benefits, and helping farmers and ranchers meet federal, state, tribal, and local environmental requirements. In the Pacific Islands, NRCS obligated 369 EQIP contracts from FY 2004—2006, targeting over 63,000 acres (255 square kilometers) for land-based conservation treatment.

During this time, NRCS estimates that over 105,000 tons (95,254 kilograms) of soil erosion was prevented through implementation of EQIP and other Farm Bill Programs, nearly half of which would likely have been transported as sediment to Pacific Island coral reef ecosystems. Practices utilized and installed by private landowners include water diversions, vegetative barriers, cover crops, hillside ditching, grassed waterways, mulching, conservation cover, terracing, and critical area seeding. Along with management practices such as nutrient and pest management, these efforts demonstrate improved stewardship of the health and quality of agricultural soils and provide secondary benefits for the nearshore marine environments.

In Puerto Rico, NRCS held two workshops on implementing agricultural conservation practices to increase the technical capacity of 15 agricultural producers in the Jobos Bay Estuary Watershed.

Development in Florida.



A new Conservation Effects Assessment Project (CEAP), located in the Jobos Bay Watershed, was initiated with NOAA in 2007. CEAP is an effort by the USDA to quantify environmental effects and benefits of conservation practices. This project will establish a CEAP Special Emphasis Watershed co-located at the Jobos Bay National Estuarine Research Reserve in Puerto Rico. Special Emphasis Watersheds are strategically located watersheds with ongoing research and demonstration activities addressing specific resource concerns, such as water quality. The Jobos Bay project–the first Special Emphasis Watershed established in the tropics–will highlight interactions between upland and coastal ecosystems, and initiate a collaborative partnership between USDA and NOAA to address spatially complex natural resource issues in coastal environments.

In St. Croix, USVI, the Bethlehem Watershed Water Quality Demonstration Project demonstrated the benefits and effectiveness of conservation management practices in the Bethlehem Watershed, a 6,660-acre (26.7 square kilometer) drainage basin. This 19-acre (76,890 square meter) farm is regularly flooded by stormwater runoff from adjacent urban areas, including a highway, streets, dirt roads, and from agricultural areas including up-stream cropland and pastureland with excessive animal concentrations on a small acreage. Conservation practices—such as water retention ponds, streambed crossing, fencing, heavy-use area protection, and critical-area stabilization—were installed to protect ground and surface waters from contamination by agri-chemicals, sediment, nutrients, and pathogens.

In Guam, private landowners have been implementing conservation practices through technical assistance offered by NRCS. In FY 2005 and 2006, conservation planning resulted in the implementation of over 160 conservation practices, contributing to the reduction of land-based pollution. NRCS is providing

technical assistance to the local Department of Agriculture—Division of Forestry and Soil Resources in the form of a conservation plan for the Coral Conservation Area, which is predominantly covered by savanna vegetation with some scrub forest.

The American Samoa Soil and Water Conservation District, in coordination with CRAG and NRCS, prepared an agreement between the local farmers and the District to grow and multiply the Vetiver grass for use in soil stabilization projects. Vetiver can be used as vegetative barriers, field borders, stream bank linings, and shoreline protection, and has proven to be a low-cost, low-technology method for significantly reducing erosion. Workshops will be conducted along with site visits to demonstrate the benefits of soil erosion control methods.

NPS, working with the University of Guam and Territory of Guam, completed a study on the relationships among wildfires, upland erosion, coral reef sedimentation, and water quality in the War-in-the-Pacific National Historic Park. The study provides a basis to formulate fire prevention and watershed restoration options in and around the Park, which is adjacent to Asan Bay. Intentional fires cause changes in native plant communities and denude areas of vegetation, resulting in wildfires and high-sediment runoff rates. Sediments in the marine environment reduce light availability and can smother corals, causing adverse impacts to coral survival, reproduction, and recruitment. Preliminary park studies in Asan Bay indicate declining levels of coral recruitment.

In the CNMI, private landowners have been implementing conservation practices through technical assistance offered by NRCS. Within the Talakhaya watershed, located on the island of Rota, CNMI, 2,500 tree seedlings were planted. The Talakhaya watershed is one of the watersheds identified in the CNMI for Local Action Strategies, Land-based Sources of Pollution (LBSP) to address the runoff and sedimentation caused by the lack of vegetative cover and annual wildfires. Ten-thousand more tree seedlings and grass plugs will be installed in June of 2007. Managaha Island, off the west coast of Saipan, is important for its endangered marine wildlife and cultural significance. The area is threatened by heavy foot traffic, shoreline erosion, and habitat encroachment. NRCS is providing technical assistance to the Department of Lands and Natural Resources and Coastal Resources Management in generating conservation practice alternatives and a conservation plan.

NRCS, with the USFWS and local CNMI agencies, initiated a project to reduce sediment flow to coral reefs by instituting traffic restrictions and planting native vegetation at the end of a beach access road. During heavy rains, the road channeled stormwater runoff and sediment onto coral reefs at Obyan Beach, Saipan, smothering reefs and altering sea turtle habitat. Additional elements of this project include educational signage, a media outreach campaign, and construction of a beach stairway to channel foot traffic to conserve native vegetation and turtle nesting areas. The plan calls for planting 11 acres (44,515 square meters) of critically eroding area with trees and shrubs, adding mulch, and rerouting foot traffic, and implementing bioengineering techniques and other management measures. The Lau Lau Watershed re-vegetation project has resulted in significant reductions in sedimentation into Lau Lau Bay and onto the Bay's coral reefs.

As part of Hawaii's land-based pollution LAS, EPA, USGS, and NRCS and other federal and local partners are collaborating with the Hanalei Watershed Hui to implement pollution

reduction activities in the Hanelei watershed, on Kaua‘i and to monitor the coral reefs. Past monitoring results showed the area of Hanalei Bay has high sediment and bacteria loading and a high prevalence of coral disease. The adverse impacts of pollutant loading in Hanalei Bay have been reduced by closing and upgrading critical cesspools on the beach and next to the river, installing check dams to trap sediments flowing out of taro fields, and constructing fences to exclude cattle from sensitive riparian areas. Related activities included a range of monitoring efforts, development of a sediment-loading model of the Hanalei watershed modified from NRCS's Annualized Agricultural Non-point Source Pollution model, assessment of sediment transport in the watershed and Bay, and plans for construction of a community wastewater collection and treatment system. On a broader scale, NRCS has worked with landowners and partnering organizations to implement over 800 conservation practices throughout Hawai‘i during FY 2004—2006.



The EPA has led strong Clean Water Act enforcement actions in Hawai‘i which have helped protect coral reefs and deter those who would violate the Act. Violations resulting in sediment damage to a coral reef on Kauai, Hawai‘i, were resolved in a settlement agreement totaling more than $7.5 million involving the EPA, DOJ, Hawai‘i, Kauai County, and Earth Justice. The violations involved grading a 400-acre (1,618,743 square meters) coastal property and filling streams without the required permits. Stormwater erosion control measures required by the permits may have prevented damage to a home, beach, and coral reef. This was the largest stormwater settlement for violations at a single site by a single landowner in the United States. The settlement includes $5.3 million to prevent erosion and restore streams at the construction site. Another 2006 settlement with the Hawai‘i Department of Transportation will result in over $50 million in improved stormwater management for highways and airports, reducing coastal pollution for Hawaii's coral reefs.

A particular problem facing the Pacific Island jurisdictions is impacts from piggeries (agricultural swine production facilities). Working with local partners in CNMI, Guam, American Samoa, Palau, and the FSM, the USDA and EPA have implemented demonstration projects for alternate waste management systems for piggeries. Dry litter waste systems and portable pen systems eliminate the use of water needed to remove waste. The dry litter waste systems not only reduce the risk of the disease Leptospirosis to humans, but also reduce nutrient loading to coral reefs. This project has been extremely effective in reducing pollution. Specific to American Samoa, the government has encouraged farmers to move piggeries away from streams, which has resulted in decreased bacteria counts in the nearshore waters adjacent to the outflows of those streams.

Further efforts in American Samoa include enhanced enforcement capability for illegal piggeries and solid waste by arranging for District Court Citation Authority, developing Piggery and Solid Waste Compliance Programs, and implementing required land-use permitting for piggeries.

In 2006, NOAA hosted community workshops in Hawai‘i, Puerto Rico, and USVI which provided specialized training and technical assistance to coastal managers and other stakeholders to enhance the effectiveness of their local planning and management capability for addressing land-based pollution sources threatening coral reef ecosystems. Workshop sessions focused on customized design guidelines for innovative and simple

Lau Lau Bay, Commonwealth of the Northern Mariana Islands



stormwater practices suited for small island development projects, and recommended practices to improve erosion and sediment control in island environments.

**Objective 2:** *Improve water quality by reducing nutrient discharges from wastewater treatment facilities, vessels, industrial sources, stormwater, agricultural sources, and air deposition.*

***Objective 3:*** *Reduce chemical pollution (e.g., oil, toxins, hazardous materials) from land-based sources and vessel discharges.*

The EPA, primarily through the Clean Water Act, plays a lead role in regulating activities and funding and/or implementing programs focused on improving water quality. Several other USCRTF agencies contribute through enforcement action, financial support, technical assistance, training, and capacity-building efforts.

The EPA, with the DOJ, worked with Guam to reduce wastewater spills during 2004—2006 by 90 percent from 2001-2002 levels. Enforcement actions resulted in marked improvements to water utility operations, which substantially decreased pollution to reefs from sewage overflows. Also in Guam, new sewer collector lines will be installed to improve wastewater infrastructure in Agat, which will prevent sewage overflows and protect coral reefs by eliminating excess nutrient loading to the ocean.

In St. Croix and St. Thomas, USVI, wastewater treatment plants have been upgraded and new ones installed to enhance water quality and ensure compliance with federal mandates under the Clean Water Act. This collaborative project involved DOI, EPA, DOJ, and USVI.

In 2006, DOJ also completed civil and criminal prosecutions against the Puerto Rico Aqueduct and Sewer Authority (PRASA) for violations of Clean Water Act. Under a settlement and

plea agreements in those cases, PRASA will spend approximately $1.7 billion to improve wastewater treatment at all of its 61 wastewater treatment plants and related collection systems over the next 15 years. The resolution of these cases will help improve the quality of life in Puerto Rico and the quality of its waters.

EPA has been assisting the USVI government as it revises its point source discharge regulations to better address stormwater runoff from construction sites. Within the year, the USVI is expected to issue a general permit, authorizing the discharge of stormwater from construction sites if specific management practices are implemented. This federally enforceable program should lead to stricter land-based erosion controls at construction sites and reduced levels of suspended solids and sediment released into sensitive coastal areas.



Working with Florida, the EPA provided a $4.3 million construction grant to the Florida Keys Aqueduct Authority for the construction of the Little Venice Wastewater Management System and continues to conduct water-quality monitoring activities. The Little Venice Wastewater Management System is an advanced wastewater treatment system including nutrient removal and disposal of treated wastewater into injection wells. The state-of-the-art system replaces hundreds of cesspits and malfunctioning septic systems contributing nutrients and other pollutants to the nearshore waters of the Florida Keys. Canal water quality was monitored for three years prior to operation of the system, and currently is being monitored to assess anticipated improvements in nearshore water quality as a result of improved sewage treatment.

In October 2006, with guidance and direction from the FKNMS Water Quality Protection Program Steering Committee (an interagency group), EPA made a $3.8 million grant to the Village of Islamorada, Florida. The purpose of this grant is to demonstrate and evaluate the centralized management of decentralized wastewater systems in the Florida Keys. This demonstration project is consistent with Monroe County's Wastewater Master Plan and will result in a significant reduction of nutrient and other pollutant loading to the nearshore waters of the Florida Keys.

The City of Marathon, Florida, developed and began implementing a comprehensive plan to address anchoring, mooring, and disposal of vessel-generated wastewater into Boot Key Harbor. This project is helping boaters comply with the requirements of the no-discharge zone (NDZ) in effect for all state waters within the boundary of the FKNMS. The NDZ was requested by the Governor of Florida and designated by the EPA in 2002 in accordance with Section 312 of the Clean Water Act. From October 2005 through September 2006, the pumpout facilities at Boot Key Harbor Marina collected and properly disposed of approximately 114,000 gallons (432 liters) of wastewater from over 9,000 vessel pumpouts, thereby improving the area's water quality.

In Puerto Rico, the USDA's Rural Development program has approved four water and sewer system projects, which will benefit near shore habitats. These projects are: the Municipality of Añasco, to implement changes to facilities threatening public health; the Municipality of Juncos, to implement sound wastewater management, which will address sewage overflows creating a public health and environmental hazard; the Municipality of Jayuya will receive sewers and a secondary treatment plant; and the La Prieta Community, Municipality of Comerío, will receive a sanitary sewer collection facility.

Sediment testing and control measures conducted in the War in the Pacific National Historic Park, Guam.





In Hawai‘i, EPA has implemented an enforcement strategy to identify and close approximately 3,000 large-capacity cesspools (LCC) in response to an EPA ban. Cesspools pose environmental and public health risks by releasing disease-causing pathogens and other contaminants to groundwater and coastal waters. As of 2006, 447 LCC in Hawai‘i have been closed under regulatory authority, 923 cesspools are being voluntarily closed, and 906 LCC are under formal enforcement actions to close. Cesspool closure and wastewater upgrades at public beach parks, schools, plantation camps, and businesses will improve water quality for Hawaii's coral reefs.

NPS, working in cooperation with the State of Hawai‘i has improved water quality at Kalaupapa National Historic Park by upgrading wastewater management to prevent pollution of the marine environment and reduce impacts on coral reefs. Park staff analyzed radioactive isotopes to measure algae as an indicator of groundwater seepage to document improvements.

EPA, DOJ, and Guam have reduced the risk of fuel spills to coral reefs in the Piti Piti Marine Park Area through upgrades to two nearby fuel tanks. EPA Enforcement Actions led to an agreement in 2001 to upgrade two large fuel tanks at a powerplant in Guam. Improvements on one tank were completed in 2005, and improvements to the second fuel tank are underway and scheduled for completion in 2006.

**Objective 4:** *Reduce the flow of marine debris and remove existing marine debris from reef ecosystems.*

Marine debris poses a threat to marine life and nearshore habitats through entanglement, ingestion, and smothering. Marine debris removal projects range from highly collaborative, large-scale activities, as exhibited in the NWHI, to smaller-scale projects targeting a specific site and implemented by a few local partners.

# Marine Debris Removal in the Northwestern Hawaiian Islands

**USCG, NOAA, the State of Hawai'i, and DOI collaborated to conduct large-scale marine debris removal efforts in the Northwestern Hawaiian Islands. From 1996 to 2006, over 560 tons of marine debris was removed from coral reef ecosystems and shorelines to protect habitat, promote navigational safety, and conserve threatened and endangered species; 21 tons were removed in 2006 alone, including three tons from the shorelines and the fringing coral reefs of Midway Atoll National Wildlife Refuge. These islands, now part of the Papahānaumokuākea Marine National Monument, are particularly prone to the accumulation of floating debris due to their central location in the North Pacific Subtropical Gyre. Most of the debris is derelict fishing gear that entangles and kills endangered Hawaiian monk seals, threatened green sea turtles, coral, and other wildlife. A recent study indicates the NWHI accumulates over 52 metric tons of debris each year, and future efforts will need to focus on removing as much of that accumulation as possible, developing techniques for collection "at sea" before it hits the reefs, and ultimately reducing the sources of marine debris.**



The NOAA Marine Debris Program led a project to assess the extent and impact of marine debris on the main Hawaiian Islands. Hot-spot debris areas were located via aerial surveys and satellite-derived products were used to create maps of debris distribution and abundance. Surveys of Kauai, Molokai, Lanai, Maui, O'ahu and the Big Island of Hawai'i are now complete. As in the NWHI, the marine debris problem in the main Hawaiian Islands has proven to be greater than expected, with 711 debris sites reported. A pilot removal effort conducted on O'ahu in 2006 removed more than 15 metric tons of debris. Maps generated during this project will aid communities and federal, state, and local coastal managers in identifying and prioritizing clean-up areas and target sites for future monitoring.

Puerto Rico, with the assistance of Amigos de Amona (a local NGO), removed one ton of derelict fishing gear and marine debris from the Mona Island Reserve in Puerto Rico. A separate effort, sponsored by NOAA, enabled the Sociedad Ambiente Marino to provide receptacles at various fishing association facilities and popular recreational and commercial fishing sites for fishermen to recycle their monofilament fishing gear. The program was so well received that a local student organization at the University of Aguadilla requested funding to install additional bins in the Aguadilla area. In 2006, at the La Parguera Natural Reserve, the reserve managers removed abandoned permanent structures from mangrove areas, such as houses, derelict live-aboard vessels, and other types of debris. Other efforts were

carried out to remove abandoned vessels in the Boquerón Bay, part of the Boquerón Natural Reserve.

The DoD and USCG play an important role in decreasing the amounts of marine debris entering ocean waters through their no-plastics discharge policies. Through shipboard pollution prevention programs and coastal and marine debris cleanup efforts, these two agencies are responsible for the abatement and removal of tons of debris nationwide and internationally.

In Florida, several ongoing programs focused on marine debris removal and prevention. In addition, special efforts were conducted to target areas impacted by hurricanes over the past few years.



The USFWS and partners continue to participate in vessel and ownership identification and removal of abandoned commercial and recreational fishing vessels; derelict live-aboard vessels or those damaged and abandoned after a hurricane; and associated marine debris such as plastics, household items, illegal artificial reefs, and assorted fishing debris. This program removes old boats and materials, which present various hazards and threaten recreational and commercial boaters, as well as marine resources.

In 2004, diver accounts of newly found debris within Florida's St. Lucie Inlet Preserve State Park led to a public meeting where individuals voiced increased concern for reef health. This meeting prompted clean-up events conducted in association with the Reef Environmental Education Foundation and FDEP's community-based Great Annual Fish Count. After fish abundance and diversity data were collected as a part of the Fish Count, divers located and removed debris, including recreational and commercial fishing nets, monofilament line, and anchors. In 2004, 120 gallons (528 liters) of marine debris was collected within only a few hours. This effort led to subsequent events for the sole purpose of removing marine debris from the reef. Support for clean-up efforts to date has included FDEP, FWC, non-profit organizations such as the Florida Oceanographic Society and Port Solerno Commercial Fishing Dock Authority, and concerned citizens.

The USDA Emergency Watershed Program helped local communities remove household and construction debris as well as vegetative refuse that was deposited in the waters after three hurricanes (Charley, Frances, and Jeanne) struck South Florida in September and October 2004. These hurricanes left over 125,000 tons of debris in 1,668 miles (2,684 kilometers) of rivers, streams, canals, and waterways. The debris removal effort prevented some of these materials from moving down stream and offshore onto coral reef ecosystems.

**Objective 5:** *Prevent and control the spread of invasive species (e.g., non-native species) in coral reef ecosystems from ballast water and other mechanisms.*

Ballast water from ships is one of the primary pathways for the intercontinental introduction and spread of Aquatic Nuisance Species (ANS). The USCG established regulations and guidelines to control the invasion of ANS and the International Maritime Organization subsequently adopted the International Convention for the control and management of ships' ballast water and sediments. This convention affects 35 percent of the gross tonnage of the world's fleet, and will help reduce the possibility of ANS introductions and interactions with coral reef resources. The


Natural Resources Conservation Service works cooperatively with local farmers.



USCG's ballast water management program applies to all vessels equipped with ballast water tanks operating in U.S. waters and bound for the United States. Highlights of the program are: (1) mandatory ballast water management practices for all vessels operating in U.S. waters; (2) establishment of additional practices for vessels entering U.S. waters after operating beyond the Exclusive Economic Zone (EEZ); and (3) reporting and record-keeping requirements of ballasting operations by all vessels. Per these regulations, all vessels with ballast tanks in all waters of the United States, regardless of the EEZ, must avoid ballast operations in or near marine sanctuaries, marine preserves, marine parks, or coral reefs.

Hawai'i, with the USFWS, created an ANS response team that has been involved in assessment and removal efforts for numerous ANSs since its establishment. One such ANS, alien seaweeds, overgrow coral reefs, reduce fisheries habitat, and cause millions of dollars in impacts to Hawaii's economy. The NPS has completed field studies for removing and controlling invasive algae *(Acanthophora spicifera)* from Kaloko Honokōhau National Historic Park. This alien algae invaded a historic native Hawaiian fish pond, which, during restoration of the fish pond, could spread to the nearby reefs, smothering them and disrupting the overall ecological balance. The study tested various removal methods for eliminating or reducing algae from the pond and preventing dispersal into nearshore waters. Surveys found no existing algae invasions to the reef area in the park. Also, in partnership with the EPA, Hawai'i developed and distributed waterproof seaweed information cards to educate boaters, divers, and anglers about alien seaweed and how to prevent its spread.

Although aquatic invasive species have an obvious negative impact on coral reef ecosystems, upland non-native agricultural

Upland river sampling off Hanelei Bay, Hawaii



plants and animals can also impact nearshore environments through increased erosion and sedimentation. The USFWS has been working in the Caribbean National Wildlife Refuges to address these issues. Removal of exotic plants and reforestation in uplands to restore native forests has helped stabilize steep areas of shoreline on Green Cay in the USVI and Culebra and Cabo Rojo in Puerto Rico. In Puerto Rico, efforts have continued to remove the invasive goat, rat, and monkey populations in the Desecheo National Wildlife Refuge. These efforts, in addition to helping recovery the island's vegetation, will reduce the erosion and sedimentation damaging nearshore coral reefs.

**Objective 6:** *Develop tools to assess and address the impacts of pollution on coral reefs.*

Florida, with NOAA and partners from the University of Central Florida, National Coral Reef Institute, College of Charleston, Haereticus Environmental Laboratory, and Broward County Environmental Protection Department, completed the pilot Southeast Florida Coral Biomarker Local Action Study, which was successfully tested the feasibility of using cellular diagnostics to link land-based sources of pollution to coral reef degradation. The pilot study report is available online at: http://www.dep.state.fl.us/coastal/programs/coral/. In 2007, a second phase of the Southeast Florida Coral Biomarker Study will expand the pilot study by incorporating screening tests for acute toxicity with exploratory contaminant analysis of pore water, sediment, and coral tissues, to identify potential sources of stress. This project will evaluate the chain of causality between land-based pollutants, the responses of individual reef-building corals, and the health of coral reef communities in the southeast Florida watershed.

A pilot study led by the USGS showed that dust collecting in the USVI during African dust conditions is toxic to some marine organisms, including the pathogenic strain of the fungus known to cause sea fan disease and mortality

of sea fans throughout the Caribbean. The USGS has developed a method to quantify the elemental composition of coral skeletons at the micron scale. This information is contributing to the goals of hindcasting the impacts of dust events on coral reef ecosystems.

USDA's NRCS and USGS soil scientists are conducting research on the surface chemistry and nutrient content of silt-size clay sediments deposited on coral reefs. These assessments indicate that, even a thin layer of sediment on a reef could foster algal blooms. The ability of silt to carry nutrients to coral reefs is a new concept for soil researchers, who previously considered silt deposition to be only a physical impairment.

In Hawai'i, the USGS is continuing to study sediment dynamics on the south shore of Molokai and Hanalei Bay, Kauai. Studies will estimate how much sediment in being transported, how long it stays on the reef, and what impact it is having. This information is critical to understanding the impacts of land-based pollution on coral reefs in Hawai'i.

**Objective 7:** *Increase awareness and understanding of the ecological health and socioeconomic impacts of land-based and marine pollution on reef resources.*

Various USCRTF partners have collaborated to host workshops and training activities to enhance knowledge and capacities needed for more effective management and mitigation of pollution impacts on coral reef ecosystems.

An international workshop held in Honolulu was titled *Assessing Land Based Pollution Stress on Coral Reefs*. States and territories focused on designing monitoring programs to investigate pollution problems and implement Local Action Strategies targeting these issues. In Hawai'i, information from this workshop is being used to develop pollutant-sensitive monitoring tools to assess the response of coral reefs to pollution reductions in nearby watersheds, as part of Hawaii's land-based pollution LAS.

A workshop held in Maui addressed innovative stormwater/wastewater technologies to help protect water quality in sensitive coastal areas. USCRTF partners, the EPA, NRCS, Hawai'i, USFWS, and NOAA contributed and participated. Outcomes of the workshop include recommendations to the County of Maui to revise local ordinances to encourage low-impact development, and recommendations to a local landowner to reduce pollutants from planned future development adjacent to a marine life conservation area.

Two additional workshops on stormwater and erosion control were held in Maui and Molokai as part of Hawaii's land-based pollution LAS. The Center for Watershed Protection, through a contract with NOAA, conducted the workshops and assisted LAS communities with watershed planning. Design guidelines for stormwater treatment practices for Maui County were also drafted, and some of the recommendations were incorporated into revised county ordinances.

EPA, NOAA, the State of Florida, Monroe County, and other local partners developed a Water Quality Communications Plan for the FKNMS. The goal of the plan is to emphasize the importance of restoring and maintaining good water quality in the Florida Keys coral reef ecosystem, including the role of individual, local, and regional impacts.